

Conserving Land and Soil

Objectives

After this lesson, students will be able to

E.4.1.1 Tell how people use land.

E.4.1.2 Describe the structure of fertile soil.

E.4.1.3 Identify problems that occur when soil is not properly managed.

Target Reading Skill

Identifying Main Ideas Explain that identifying main ideas and details helps students sort the facts from the information into groups. Each group can have a main topic, subtopics, and details.

Answers

Possible answers include the following:

- **Detail:** Agriculture—new farmland is created by clearing forests, draining wetlands, and irrigating deserts.
- **Detail:** Mining—strip mines expose the soil, which can then be blown or washed away more easily.
- **Detail:** Development—as populations grow, people build more houses and paved roads.

All in One Teaching Resources

- [Transparency E28](#)

Preteach

Build Background Knowledge

Soil Components

Ask: **What is soil made of?** (*Rock that was broken down into very small pieces over time; accept other reasonable responses without comment at this time.*) **What else does soil contain?** (*Students may mention minerals, nutrients, dead and living organisms.*)

Conserving Land and Soil

Reading Preview

Key Concepts

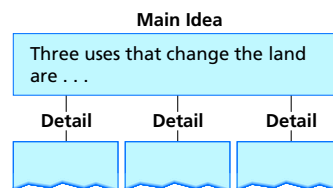
- How do people use land?
- What is the structure of fertile soil?
- What kinds of problems occur when soil is not properly managed?

Key Terms

- development • litter
- topsoil • subsoil • bedrock
- erosion • nutrient depletion
- fertilizer • desertification
- drought • land reclamation

Target Reading Skill

Identifying Main Ideas As you read the "Types of Land Use" section, write the main idea in a graphic organizer like the one below. Then write three supporting details that give examples of the main idea.



Lab Zone

Discover Activity

How Does Mining Affect the Land?

1. You will be given a pan filled with sand and soil that represents a mining site. There are at least ten deposits of "ore" (sunflower seeds) buried in your mining site.
2. Your goal is to locate and remove the ore from your site. You may use a pencil, a pair of tweezers, and a spoon as mining tools.
3. After you have extracted the chunks of ore, break them open to remove the "minerals" inside.
CAUTION: Do not eat the sunflower seeds.
4. Observe your mining site and the surrounding area after your mining operations are finished.



Think It Over

Predicting How did mining change the land at your mining site? Predict whether it would be easy or difficult to restore the land to its original state. Explain.

Less than a quarter of Earth's surface is dry, ice-free land. Except for a small amount that forms when volcanoes erupt, new land cannot be created. All the people on Earth must share this limited amount of land to produce their food, build shelter, and obtain other resources. Land is a precious resource. As the American author Mark Twain once said about land, "They don't make it anymore."

▼ A dairy farm



Lab Zone

Discover Activity

Skills Focus Predicting

Materials pan, mixture of sand and soil, sunflower seeds, pencil, tweezers, spoon, paper towel. For each student or small group, fill a pan about half full with a mixture of sand and soil. Bury 10–15 sunflower seeds in the mixture, and then smooth the surface to hide the seeds.

L1

CAUTION: Make sure students wash their hands when they finish.

Time 10 minutes

Tips Allow students to use any of the listed methods to locate and extract the seeds.

Expected Outcome The site will have many holes and mounds of dirt.

Think It Over The land is changed significantly when a site is mined. Restoring it is difficult; holes must be filled, the excavated soil replaced and regraded, and the land replanted.

Types of Land Use

People use land in many ways. **Three uses that change the land are agriculture, mining, and development.**

Agriculture Land is the source of most of the food that people eat. Crops such as wheat, rice, and potatoes require large areas of fertile land. But less than a third of Earth's land can be farmed. The rest is too dry, too wet, too salty, or too mountainous. To provide food for the growing population, new farmland is created by clearing forests, draining wetlands, and irrigating deserts. When people make these changes, organisms that depend on the natural ecosystem either find new homes or die off.

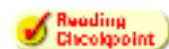
Not all agricultural land is used to grow food for people. Some land is used to grow food for livestock. Some animals, such as cows and horses, also require pasture or rangeland for grazing. And some land is used to grow crops other than food, such as cotton.

Mining Mining is the removal of nonrenewable resources from the land. Resources just below the surface are strip mined. Strip mining involves removing a strip of land to obtain minerals and then replacing the strip. Strip mines expose the soil, which can then be blown or washed away more easily. Strip-mined areas may remain barren for years before the soil becomes rich enough to support plant growth again.

For resources located deep underground, it is necessary to dig a tunnel, or shaft. The minerals are carried up through the shafts. This process is called underground mining.

Development People settled first in areas that had good soil and were near a source of fresh water. As populations grew, these settlements became towns and cities. People built more houses and paved roads. The construction of buildings, roads, bridges, dams, and other structures is called **development**.

In the United States, about a million hectares of farmland (an area half the size of New Jersey) are developed each year. Development not only reduces the amount of farmland, but can also destroy wildlife habitats.



Why isn't all land suitable for farming?

FIGURE 1

Development

Some of the land on Earth has been developed for the construction of houses.



Instruct

Types of Land Use

Teach Key Concepts

L2

How People Use Land

Focus Remind students that people need land for housing, food, and natural resources.

Teach Tell students that three uses that change land are agriculture, mining, and development. Point out that less than a third of Earth's land can be farmed. Ask: **How can new farmland be created to feed the growing population?** (*Clearing forests, draining wetlands, and irrigating deserts*) Explain that mining minerals by strip mining exposes the soil. Ask: **What happens to the soil when it is strip mined?** (*It is exposed and can be blown or washed away more easily.*) **What happens to wildlife when land is developed for settlements or farmland?** (*The habitats of wildlife are destroyed.*)

Apply Ask: **What examples of the three types of land uses have you seen?** (*Answers will vary. Possible answer: An area of trees or a forest was cut down to make space for building houses.*) **learning modality: logical/mathematical**

Independent Practice

L2

All in One Teaching Resources

- [Guided Reading and Study Worksheet: Conserving Land and Soil](#)



Student Edition on Audio CD

Differentiated Instruction

Less Proficient Readers

L1

Making a Concept Map Have students make a concept map of the three types of land uses. Their maps should include a description of each type and how each type changes the land. **learning modality: visual**

Special Needs

L1

Visualizing Land Use Locate photographs in encyclopedias or on the Internet that show examples of the three types of land use. Point to corresponding pictures as you review the types with students. Encourage students to locate other examples in illustrated reference books. **learning modality: visual**

Monitor Progress

L2

Oral Presentation Call on students at random to describe the various kinds of land use and how they affect the natural ecosystems of the land.

Answers



Much of Earth's land is too dry, too wet, too salty, or too mountainous to be farmed.

The Structure of Soil

Teach Key Concepts

L2

Soil Layers

Focus Remind students that good soil is necessary for one of the uses of land—agriculture.

Teach Ask: **What does soil contain that plants need to grow?** (*Minerals and nutrients*) **How does soil help break down waste?** (*It contains bacteria, fungi, and other organisms that help break down waste.*) **What natural processes break up bedrock?** (*Freezing, thawing, acids in rainwater and chemicals released by lichens, and plant roots that wedge between rocks*) Have students look at Figure 2, and ask a student volunteer to read the definition of each layer of soil.

Apply Ask students to identify the layer of soil where each of the following is most likely to be found: **Rock fragments but only a small amount of animal and plant matter** (*Subsoil*), **water and nutrients absorbed by many plant roots** (*Topsoil*), **dead leaves and grass** (*Litter*), **rock** (*Bedrock*). **learning modality: visual**

All in One Teaching Resources

- [Transparency E29](#)

Help Students Read

L1

KWL Refer to the Content Refresher, which provides the guidelines for KWL.

Before students read *The Structure of Soil*, have them construct a KWL chart with three columns: *What I Know*, *What I Want to Know*, and *What I Learned*. Tell them to fill out the first two columns. After they have read pages 118–120, have them fill out the final column.



For: Links on erosion
Visit: www.SciLinks.org
Web Code: scn-0541

Download a worksheet that will guide students' review of Internet resources on erosion.

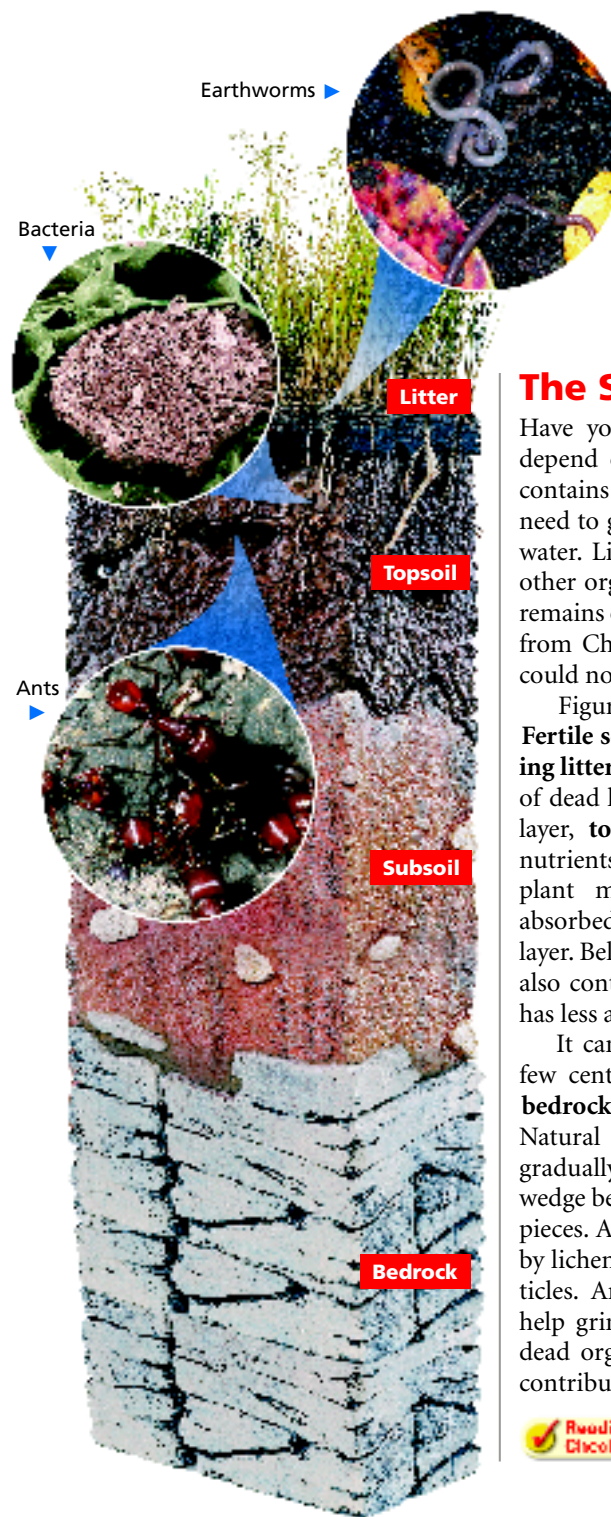


FIGURE 2

Soil Structure

Soil consists of several layers.

Organisms such as ants, earthworms, and bacteria live mostly in the topsoil. **Applying Concepts** In which layer are most plant roots located? What do the roots absorb there?

The Structure of Soil

Have you ever thought about how much you depend on soil? You probably haven't. But soil contains the minerals and nutrients that plants need to grow. Soil also absorbs, stores, and filters water. Living in soil are the bacteria, fungi, and other organisms that break down the wastes and remains of living things. (Recall the nitrogen cycle from Chapter 2.) Without soil, most life on land could not exist.

Figure 2 shows the structure of fertile soil. **Fertile soil is made up of several layers, including litter, topsoil, and subsoil.** The very top layer of dead leaves and grass is called **litter**. The next layer, **topsoil**, is a mixture of rock fragments, nutrients, water, air, and decaying animal and plant matter. The water and nutrients are absorbed by the many plant roots located in this layer. Below the topsoil is the **subsoil**. The subsoil also contains rock fragments, water, and air, but has less animal and plant matter than the topsoil.

It can take hundreds of years to form just a few centimeters of new soil. All soil begins as **bedrock**, the rock that makes up Earth's crust. Natural processes such as freezing and thawing gradually break apart the bedrock. Plant roots wedge between rocks and break them into smaller pieces. Acids in rainwater and chemicals released by lichens slowly break the rock into smaller particles. Animals such as earthworms and moles help grind rocks into even smaller particles. As dead organisms break down, their remains also contribute to the mixture.



What is the first step in the process of soil creation?



Terracing ▲



Windbreaks ▲

Soil Management

Because rich topsoil takes so long to form, it is important to protect Earth's soil. **Poor soil management can result in three problems: erosion, nutrient depletion, and desertification. Fortunately, damaged soil can sometimes be restored.**

Erosion The process by which water, wind, or ice moves particles of rocks or soil is called **erosion**. Normally, plant roots hold soil in place. But when plants are removed during logging, mining, or farming, the soil is exposed, and erosion occurs more easily. Some farming methods that help reduce erosion are shown in Figure 3.

Nutrient Depletion Plants make their own food through photosynthesis. But plants also need nutrients such as the nitrogen, potassium, and phosphorus found in soil. Decomposers supply these nutrients to the soil as they break down the wastes and remains of organisms. But if a farmer plants the same crops in a field every year, the crops may use more nutrients than the decomposers can supply. The soil becomes less fertile, a situation called **nutrient depletion**.

When soil becomes depleted, farmers usually apply **fertilizers**, which include nutrients that help crops grow better. Farmers may choose other methods of soil management, however. Fields can be periodically left fallow, or unplanted. The unused parts of crops, such as cornstalks, can be left in the fields to decompose, adding nutrients to the soil. Farmers can also rotate crops. In crop rotation, a farmer alternates crops that use many nutrients with crops that use fewer nutrients or crops that restore nutrients.

FIGURE 3
Reducing Erosion

Terracing and windbreaks help prevent erosion. In terracing, hillsides are built up into a series of flat "terraces." The ridges of soil at the edges slow runoff and catch eroding soil (left). Windbreaks such as rows of trees block wind and help keep soil from eroding (right).

Go  online

SCILINKSSM 

For: Links on erosion
Visit: www.SciLinks.org
Web Code: scn-0541

Soil Management

Teach Key Concepts

L2

Protecting Earth's Soil

Focus Remind students that soil can take hundreds of years to form.

Teach Ask: **What happens when soil is exposed?** (*Erosion occurs more easily.*) **What farming practice contributes to nutrient depletion?** (*Planting the same crops in a field every year*) **How can farmers prevent this?** (*Apply fertilizers, leave fields unplanted periodically, and rotate the crops*) **What are some causes of desertification?** (*Climate, overgrazing of grasslands, and cutting down trees*)

Apply Ask students to discuss the time and expense of managing soil. **learning modality: logical/mathematical**



L2

Observing Soil Layers

Materials glass jars with screw-on lids, water, soil samples, hand lens

Time 20 minutes over 2 days

Focus Review the layers of soil.

Teach Ask students to bring in about 500 mL of soil (removing any visible living organisms and leaving them at the location). Have students put their soil in jars, add water to cover it, screw on the lid, and then shake the jar gently to mix the soil and water. Remind students to wash their hands. Leave the jars undisturbed overnight and examine them the next day.

Apply Ask: **What do you see in the jar now?** (*The largest and most dense particles will have settled in the bottom and finest particles at the top.*) Ask students to identify any layers of soil in their samples. **learning modality: kinesthetic**

Monitor Progress

L2

Drawing Have students draw a labeled diagram of soil layers.

Answers

Figure 2 Topsoil; water and minerals



The breakup of bedrock into smaller pieces of rock

Use Visuals: Figure 4

L2

Areas of Desertification

Focus Review the meaning of the key term *desertification*.

Teach Ask students to name areas of existing deserts. (*Southwestern U.S., the southern part of South America, the northern part of Africa, a small part of central Asia, and much of Australia*) Have students compare this map with the maps of the desert and grassland biomes in Chapter 2. Ask: **Which type of biome is most threatened by desertification? Why?** (*Grasslands; these areas tend to be dry, so wind erodes exposed soil.*)

Apply Ask students to identify methods to slow or reduce desertification based on what they have learned in this section. (*Possible answer: Terracing, windbreaks, not allowing livestock to overgraze, not cutting down trees*)

learning modality: visual

Lab zone Teacher Demo

L1

Modeling Soil Conservation

Materials mixture of sand and soil, spray bottle, 2 deep pans, water, small handheld rake or large fork

Time 15 minutes

Focus Tell students that runoff of water is the main cause of erosion.

Teach Pile up sand and soil in a mound in each pan. Spray one mound with water to show how easily the soil flows downhill. On the other mound, use the rake to make small grooves that encircle the pile, and then gently spray the mound. Explain that farmers plow grooves such as these to follow the contour of the land.

Apply Ask: **How did the grooves help prevent erosion?** (*The water collected in the grooves before running downhill and carrying away the soil.*) **learning modality: visual**

Desertification If the soil in a once-fertile area becomes depleted of moisture and nutrients, the area can become desert-like. The advance of desert-like conditions into areas that previously were fertile is called **desertification** (dih zurt uh fih KAY shun). In the past 50 years, desertification has occurred on about 5 billion hectares of land.

One cause of desertification is climate. For example, a **drought** is a period when less rain than normal falls in an area. During droughts, crops fail. Without plant cover, the exposed soil easily blows away. Overgrazing of grasslands by cattle and sheep also exposes the soil. In addition, cutting down trees for firewood can expose soil and cause desertification.

Desertification is a very serious problem. People cannot grow crops and graze livestock where desertification has occurred. As a result, people may face famine and starvation. In central Africa, where desertification is severe, millions of rural people are moving to the cities because they can no longer support themselves on the land.

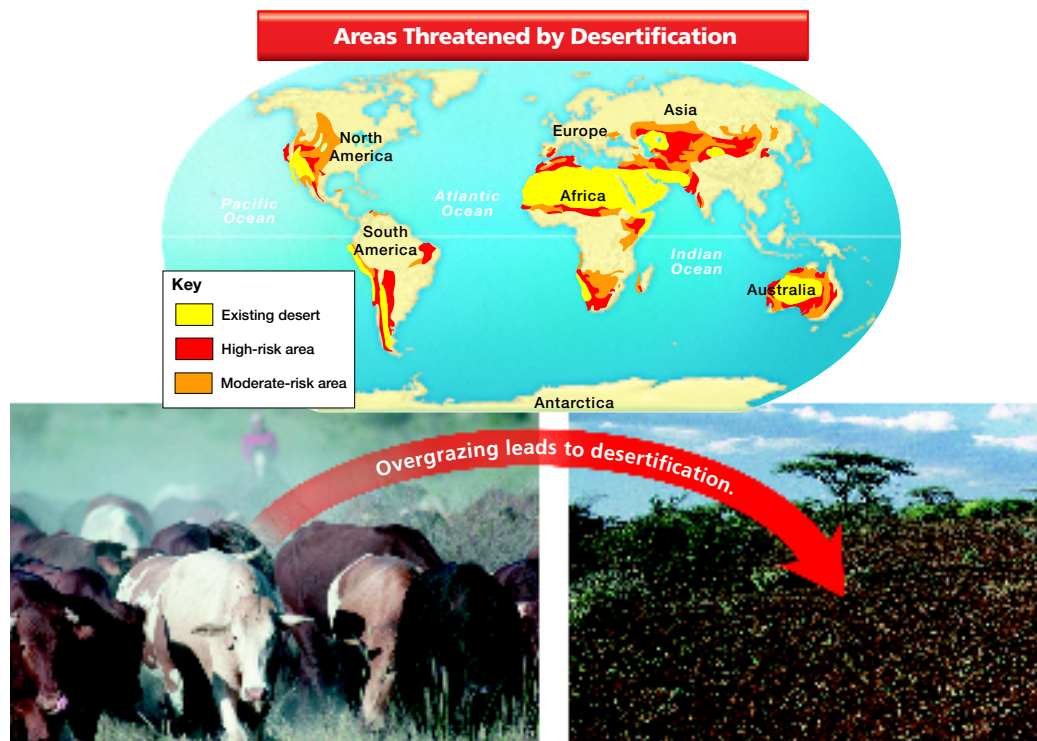


What are three causes of desertification?

FIGURE 4

Large areas of the world are at risk of desertification. One cause is overgrazing. Without grass to hold the soil in place, grasslands can become deserts.

Interpreting Maps In which biome are most of the areas at risk of desertification located? (Hint: Refer to Chapter 2.)



Differentiated Instruction

Special Needs

Understanding Land Reclamation Ask students to relate the text's description of erosion to their own direct experience. If students did the Discover Activity at the beginning of the section, ask: **What did your mining site look like when you finished?** (*The site was full of holes and*

L1

piles of soil.) Have students recall their predictions about how easy or difficult it would be to restore the land. Ask: **Now that you have read about erosion, do you think it would be difficult to restore eroded croplands?** (*Yes; the subsoil and topsoil would have to be replaced after continued erosion.*) **learning modality: verbal**



Before



After

Monitor Progress L2

Answers

Figure 4 Grassland biome



Climate, overgrazing, cutting down trees

Assess

Reviewing Key Concepts

1. **a.** Agriculture, development, mining
b. Farmland is created by clearing forests, draining wetlands, and irrigating deserts; development destroys wildlife habitats; mining removes the land and exposes the soil. **c.** All types of land use would increase and change the land further to meet the needs of a growing population.
2. **a.** Litter is a layer of dead leaves and grass. Topsoil is a mixture of rocks, nutrients, water, air, and decaying organic matter. The subsoil has rocks, nutrients, water, and air, but less decaying matter. Bedrock is the rock that makes up Earth's crust. **b.** Pesticides could destroy animals, such as earthworms, that grind rocks into smaller particles as part of soil formation.
3. **a.** Erosion, nutrient depletion, desertification **b.** Overgrazing of grasslands or tree cutting during drought conditions exposes the bare soil. Wind and water can erode soil that has no plant cover. **c.** The farmer could build up the soil into terraces, which slow runoff and catch eroding soil.

Reteach L1

Call on students to name key terms as you provide the definitions. Then have students describe how each word relates to land use, structure of soil, or to soil management.

Performance Assessment L2

Writing Have students briefly explain the major problems and prevention of poor soil management.

All in One Teaching Resources

- [Section Summary: Conserving Land and Soil](#)
- [Review and Reinforce: Conserving Land and Soil](#)
- [Enrich: Conserving Land and Soil](#)

Land Reclamation Fortunately, it is often possible to restore land damaged by erosion or mining. The process of restoring an area of land to a more natural, productive state is called **land reclamation**. In addition to restoring land for agriculture, land reclamation can restore habitats for wildlife. Many different types of land reclamation projects are currently underway all over the world. But it is generally more difficult and expensive to restore damaged land and soil than it is to protect them in the first place.

Figure 5 shows an example of land reclamation. When the mining operation in the first scene was completed, the mine operators smoothed out the sides of the mining cuts. Then they carefully replaced the subsoil and topsoil that had been removed before mining. Finally, they planted grass and trees. The former mine is now becoming a wooded area.

FIGURE 5

Land Reclamation

It's hard to believe that this wooded area used to be an open mine. Thanks to land reclamation practices, many mining areas are being restored for other uses.

Section 1 Assessment

Target Reading Skill Identifying Main Ideas Use the graphic organizer you created to help you answer Question 1 below.

Reviewing Key Concepts

1. **a. Identifying** What are three ways that people use land?
b. Explaining For each land use, describe how it changes the land.
c. Predicting How would you expect each type of land use to change if the world's population were to continue to increase?
2. **a. Reviewing** Describe the different layers of fertile soil in order, from the surface downward.
b. Relating Cause and Effect If large amounts of pesticides are applied to soil, the process of soil creation may be negatively affected. Why might this be the case?
3. **a. Listing** List three problems that can occur when soil is not properly managed.
b. Comparing and Contrasting How are the causes of desertification related to erosion?
c. Developing Hypotheses Suppose that a farmer's field is on a slight hill. How might this farmer reduce erosion of his field?

Writing in Science

Description Imagine that you are holding a lump of fertile soil in your hand. Write a paragraph describing its texture, appearance, smell, and anything else you would observe. Be sure to use a variety of adjectives in your paragraph.

Lab zone Chapter Project

Keep Students on Track



CAUTION: Make sure students handle scissors carefully. Review the safety guidelines in Appendix A. Encourage students to begin examining and analyzing packaging materials of various products. Advise them to think about the purpose of the packages and how they are discarded.

Writing in Science

Writing Mode Description

Scoring Rubric

- 4 Includes several senses and a variety of adjectives to describe the attributes of soil
- 3 Includes criteria, but adjectives are not as vivid
- 2 Includes only brief description
- 1 Includes only a list with no description